Exploring Technological Pedagogical Content Knowledge (TPACK) Among Visual Arts Teachers

Mehmet Ali Gökdemir [i]
Dicle University

Abstract

This study investigated the levels of Technological Pedagogical Content Knowledge (TPACK) among visual arts teachers in the Diyarbakır region during the 2023-2024 academic year, considering various demographic variables. Using a descriptive survey design and a quantitative approach, the study involved 152 visual arts teachers selected through convenience sampling. Data were collected using a demographic information form and the Technological Pedagogical Content Knowledge Scale. The results indicated a high proficiency across all dimensions of TPACK: technology knowledge, pedagogical knowledge, content knowledge, and the integrated TPACK construct. Furthermore, no significant differences in TPACK levels were observed based on gender, socioeconomic status, participation in educational technology training, or years of teaching experience. These findings suggest that visual arts teachers in the Diyarbakır region possess strong capabilities in the various knowledge domains that contribute to effective technology integration in teaching. The study underscores the importance of incorporating technological advancements into visual arts curricula and teacher training programs, with a focus on developing TPACK. It is recommended that pre-service teachers be provided with practical experiences to enhance their competence in integrating technology within educational contexts.

Keywords: TPACK, visual arts, visual arts teachers, technology integration, teacher education

DOI: 10.29329/ijpe.2024.1063.2

Submitted: 08/06/2024 **Accepted:** 20/09/2024 **Published:** 01/10/2024

----

[i] **Mehmet Ali Gökdemir,** Assist. Prof. Dr., Art Education, Dicle University, ORCID: 0000-0002-5100-5026

Email: maligokdmr@gmail.com

INTRODUCTION

The current century is shaped by rapid developments in technology, which have revolutionized various aspects of human life. Technological inventions that are the product of these developments have enhanced efficiency in human life in various domains. Computers have emerged as indispensable tools in all sectors, particularly in terms of the convenience they offer such as processing, sharing, securing and accessing digital information (Tekinarslan, 2008, p. 187). The opportunities offered by technology have made it inevitable for technological inventions to be used in the field of education as well. In this regard, technological inventions have become effective tools in both formal and non-formal education to educate children and adults (Öztürk and Horzum, 2011, p. 256). The incorporation of technological advancements into education and training has led to remarkable changes in the teaching process, prompting the evaluation and update of traditional teaching methods (Akyürek, 2020, p.7). The shift from traditional methods to technology-based education approaches has required to reconsideration of the teaching methods and scope with the demands of the digital age (Alakoç, 2003, p.48). As outlined by Kurt (2012, p.9), various models have been suggested including the Communication Technology Integration Model, Apple Future Classes Model Technology Integration Model, Systematic Knowledge, Technological Pedagogical Content Knowledge Model and the Improved Pierson Model. These models are employed in educational settings based on the integration of technological infrastructure, equipment and systems into educational environments. Thus, there is an increasing interest in teacher training programs in higher education to update their curriculum to adopt technology-based approaches. Considering the changes in teacher training programs in higher education throughout the historical process, there has been a shift in focus from stressing teachers' field of knowledge to understanding the significance of pedagogical knowledge in effective teaching (Aslan Altan, 2016, p. 16). Nowadays, there is a growing understanding that teachers need to hold both technological knowledge, content knowledge and pedagogical knowledge thanks to the developments in technology. In this vein, technology-driven models have begun to be used in the teaching and learning process. The integration of technological advancements into education and pedagogy has led to the emergence of one such model, which is the Technological Pedagogical Content Knowledge (TPACK) (Koehler and Mishra, 2005 cited in Ekici & Dereli, 2022, p. 243).

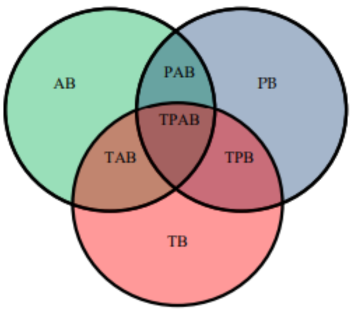

Figure 1: Technological Pedagogical Content Knowledge Model (Mishra and Koehler, 2006 cited in Topçu & Masal, 2020, p.150).

Technology Knowledge (TK): Technological knowledge (TK) encompasses familiarity with both traditional and advanced technologies, ranging from conventional tools like books and blackboards to more sophisticated digital platforms such as the Internet and digital video. It involves not only understanding how to utilize these technologies but also possessing the requisite skills to operate them effectively. For instance, proficiency in digital technologies necessitates knowledge of operating systems, and computer hardware, and competence in utilizing standard software applications like word processors, spreadsheets, web browsers, and email clients (Mishra & Koehler, 2006, p. 1027). Contemporary technological expertise further extends to encompass the utilization of diverse tools such as tablet computers, mobile devices, and interactive whiteboards, alongside online presentation platforms like Prezi, and engagement with social networks such as Facebook and Twitter (Yurdakul & Odabaşı, 2013, p.44).

Pedagogical Knowledge (PK): Pedagogical knowledge (PK) encompasses educators' understanding of instructional processes, teaching methodologies, and learning practices. It involves comprehension of student learning mechanisms, proficiency in classroom management, development of lesson plans, utilization of diverse teaching techniques, and the ability to assess student comprehension effectively. A teacher possessing PK comprehends how students organize knowledge, acquire skills, and cultivate attitudes towards learning. Hence, PK necessitates familiarity with cognitive, social, and developmental theories of learning and their application within the classroom setting (Koehler & Mishra, 2009, p. 63). As emphasized by Archambault and Crippen (2009, p. 73), PK encompasses a repertoire of instructional practices, methodologies, strategies, and pedagogical approaches aimed at facilitating effective teaching and learning experiences.

Ccontent Knowledge (CK): CK includes all of the objectives and subjects intended to be taught (Azgın and Şenler, 2018). In other words, content knowledge (CK) is general knowledge about the subject matter that teachers will teach. Content knowledge is of great importance for a teacher (Gündüz, 2028, p.8). Shulman (1986) pinpoints that content knowledge is a field that includes theories, concepts, ideas organizational structures, and current practices to develop such knowledge. The nature of research and knowledge causes major changes across different fields. In this context, each teacher must strive to have in-depth knowledge of the field. Teachers who do not have sufficient knowledge about their field may misrepresent the subjects to their students (Koehler & Mishra, 2009).

Technological Pedagogical Content Knowledge (TPACK): Technological Pedagogical Content Knowledge (TPACK) is a conceptual framework that emphasizes the seamless integration of technology into educational contexts, encompassing teachers' proficiency in technological, pedagogical, and content domains. It revolves around the deliberate selection and application of instructional methods and techniques, augmented by technology, to enhance the coherence and effectiveness of subject matter delivery. Fundamentally, TPACK embodies the capacity to adeptly incorporate contemporary technological tools within the dynamics of classroom instruction and learning processes (Çoban, Akpınar, Baran, Sağlam, Özcan & Kahyaoğlu, 2016).

Research Problem

The teaching profession, regarded as sacred and continuously evolving, has existed throughout human history (Çiğilli & Eyaman, 2023, p. 48). Today, teachers’ roles and competencies may differ across the rapidly changing social structure. The pace of innovation necessitates environments that can adapt accordingly, highlighting the urgent need for the training of competent and well-equipped educators (Kazu & Yenen, 2014). The skills that teachers have directly affect the effectiveness of the teaching and learning process. Teachers’ effort in the teaching-learning process, focusing on individual differences by employing different teaching methods and techniques, has positive effects on fostering students' motivation and achieving course objectives (Çiğilli & Eryaman, 2023, p.49). In this regard, teacher skills in the education and training process play a pivotal role in achieving the objectives of the process. As outlined by Kırışoğlu (2005), visual arts teachers, who are expected to possess fundamental competencies such as creating an environment that stimulates students’ creativity and inspiring them to produce original works, need to keep up with these developments. Moreover, they must possess sufficient content knowledge to meet the objectives efficiently in the learning-teaching process (Özsoy, 203, p.124). Visual arts teachers need to keep up with rapidly developing and changing technology to adapt their content knowledge to the course efficiently (Bülbül, 2021, p.707). Besides, the COVID-19 global epidemic, which emerged in China's Wuhan province in 2020 and affected the whole world, as well as the earthquake disaster in our country on February 6, 2023, have led to the transition to online education and training. The shift to online education and training has underscored the significance of teachers having not only technology knowledge but also pedagogical and content knowledge. Under the strength of these events; visual arts teachers with technological pedagogical content knowledge will be better prepared to navigate the changing education era due to today's technological changes and impart the course objectives to students more effectively. Otherwise, those lacking technological pedagogical content knowledge may encounter problems in classroom management and guiding students to achieve the objectives of the visual arts curriculum.

After reviewing pertinent literature within the Turkish context, several investigations have been undertaken concerning teachers' technological pedagogical content knowledge (TPACK) (Bakaç & Özen, 2018; Canbazoğlu Bilici & Baran, 2015; Çiğilli & Eryaman, 2023; Doğan & Doğan, 2022; Demirezen & Keleş, 2020; Gömleksiz & Fidan, 2013; Kalemkuş & Bulut Özek, 2022; Karalar & Aslan Altan, 2016; Karakuyu & Karakuyu, 2016; Karadeniz & Vatanartıran, 2015; Saykal & Uluçınar Sağır, 2021; Özdemir & Erduran, 2019). However, there exists a noticeable absence of studies specifically addressing the technological pedagogical content knowledge levels among visual arts educators. Recognizing this gap, the current study endeavours to bridge this deficiency in the literature by examining the technological pedagogical content knowledge competencies of visual arts teachers. This research holds significance in terms of filling the existing void, shedding light on the TPACK competencies of visual arts educators, and providing valuable insights for future scholars in the field.

Aim of Research

This study endeavours to investigate the extent of technological pedagogical content knowledge (TPACK) among visual arts educators, with a focus on various influencing factors. To achieve this objective, the study addresses the following inquiries:

1. What is the proficiency level of TPACK among visual arts instructors?

2. Is there a statistically significant difference in TPACK levels among visual arts educators based on gender?

3. Do the TPACK levels of visual arts teachers exhibit significant variance concerning the socio-economic status of the schools they are employed in?

4. Are there significant disparities in TPACK levels among visual arts instructors based on their participation in in-service training programs related to educational technologies?

5. Do the levels of TPACK among visual arts educators significantly vary based on their years of teaching experience?

By investigating these questions, the study aims to provide insights into the current status and influencing factors of TPACK among visual arts educators.

METHOD

Research Design

This study employed a descriptive survey approach, a quantitative research methodology commonly utilized to elucidate the characteristics of a phenomenon or situation. The fundamental objective of the descriptive survey model is to provide a detailed portrayal of individuals' opinions, attitudes, beliefs, and demographic attributes within the educational domain (Johnson & Christensen, 2014). According to Karakaya (2012, p.59), a descriptive survey entails the collection of data to examine the attitudes and opinions of large cohorts regarding an event or phenomenon, to delineate the subject under investigation. In alignment with this framework, the present study employed a descriptive survey method to scrutinize and delineate the levels of technological pedagogical content knowledge among visual arts educators across various variables.

Participants

The study encompassed 152 visual arts teachers working in Diyarbakır during the 2023-2024 academic year. Participants were selected by the convenience sampling method, a non-random sampling method. The convenience sampling method is based on saving the researcher’s money, work and time. The method involves selecting the most accessible and economical sample or situation until the desired sample size is achieved (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2010; Gürbüz & Şahin, 2015).

The convenience sampling method was chosen for its ability to save labour, money and time, as well as its ease of accessibility. Mujis (2004) emphasizes that convenience sampling is widely used in educational research due to its practicality and cost-effectiveness. Besides, this sampling method has some limitations in terms of its ability to accurately represent the population, which could be regarded as a limitation of the study.

Table 1. Demographic information regarding the participants

Gender	f	%
Female	66	43,4
Male	86	65,6
Socio-Economic Level of the School Where They Work	f	%
Low	54	35,5
Medium	87	57,2
High	11	7,2
Taking Courses on Educational Technologies	f	%
Yes	70	46.1
No	82	53,9
Year of Service	f	%
0-1 years	44	28,9
2-4 years	35	23
5-7 years	17	11,8
8-10 years	14	9,2
11 and over	42	27,6
Total	152	

Table 1 summarizes participant demographics, indicating that the majority of the sample comprises male participants (86%). Besides, most of the participants (87%) work in schools with a medium level of socio-economic level. Moreover, the majority of participants have not participated in any educational technology courses (82%). Regarding year of service, the largest portion of participants (44%) reported having 0-1 years of experience.

Data Collection Tools

This study deployed two data collection tools.

1. Personal Information Form: A demographic information form was developed to gather relevant data regarding visual arts teachers. This form includes questions related to gender, socioeconomic status of the school, participation in educational technology-related in-service training courses, and years of service. The form was prepared by an extensive literature review and expert views.

2. Technological Pedagogical Content Knowledge Scale: The study employed a 51-item Likert scale, developed by Horzum, Akgün and Öztürk (2014), to measure visual arts teachers' technological pedagogical content knowledge. The content validity index and content validity ratio of the scale were between -1 and 1. These findings indicated high agreement among experts regarding the content validity ratio and content validity index of the scale items. The results of the confirmatory factor analysis suggested that the observed data were by the TPACK framework, representing a 7-factor theoretical model.

The calculated chi-square value for the model was statistically significant due to the large sample size. The "X^2/sd" ratio was calculated as 2.40, indicating an acceptable fit for the model. Modification indices of the scale noted a strong relationship between the error covariances of the 15th and 16th items, which belonged to the same latent variable. Therefore, it was decided to release the error covariances of these items and conduct confirmatory factor analysis once again. Accordingly, the chi-square value obtained in the second-factor analysis was statistically significant (x^2=2735.09, N=724, df=1202, p=.000).

The "X^2/sd" ratio was calculated as 2.28, indicating a good fit. The correlations across the factors of the TPACK scale were examined through Pearson correlation. In this regard, the correlation between the factor scores was identified to be between .51 and .92. These findings showed a high level of relationship and consistency between the factors. Reliability was further assessed through test-retest and internal consistency coefficients. Additionally, corrected item-total correlations were calculated, and a t-test was conducted to compare the averages of the 272% lower group and the 27% upper group. The test-retest study involved 21 students filling out the scale twice, one week apart. The test-retest results suggested significant and positive correlation coefficients between the items.

These values varied between .65 and .92. The correlations between the factor scores of the scale ranged from .91 to .95 with all items demonstrating significant and positive correlations. In addition, the correlation coefficient of total scores was calculated as .98. These significant and positive values show the test-test reliability of the TPACK scale. Cronbach's alpha internal consistency values for the 7 factors varied between .84 and .89. In addition, a t-test was conducted for each item and factor to compare the lower 27% and upper 27% groups, referring to a significant difference (p <.01). In line with all these findings, TPACK is considered a reliable measurement tool.

Data Collection

Data collection took place in the fall semester of the 2023-2024 academic year between 05-13/09/2023. An ethics committee decision was issued from Dicle University Rectorate Legal Consultancy dated 18.07.2023 and numbered 530981, and the necessary permissions were obtained to collect data. Participant consent was obtained, and data collection was conducted voluntarily. Each participant was provided with a statement of voluntary participation before completing the scale. The data were collected at a time that would not adversely affect the lessons of visual arts teachers. Each participant completed the personal information form and scale items within an average of 15 minutes. All stages of the study adhered to ethical principles.

Data Analysis

The data analysis for the Technological Pedagogical Content Knowledge (TPACK) scale was carried out using a statistical package program. Multivariate Analysis of Variance (MANOVA) and descriptive statistics were employed for the analysis. The MANOVA procedure necessitates the fulfilment of specific assumptions within the dataset, including verifying homogeneity of variances, adherence to multivariate normality, absence of multicollinearity, and homogeneity of variance-covariance matrices (Akbulut, 2011; Can, 2019; Field, 2009; Pallant, 2020; Seçer, 2015). Initially, an assessment was conducted to ascertain whether the data met the general conditions for parametric testing. The Kolmogorov-Smirnov test was utilized to determine whether the data exhibited a univariate normal distribution. The results indicated a non-normal distribution for various factors of the TPACK scale.

Subsequently, a Q-Q plot analysis was conducted, along with an examination of skewness and kurtosis values, as recommended by Can (2019), Ho (2006), Seçer (2015), and affirmed by Bachman (2004). The skewness and kurtosis values of the data fell within the acceptable range of +2.00 to -2.00, indicative of normal distribution. Extreme values were identified and subsequently excluded from the analysis to ensure robustness.

Box's M test was employed to assess the assumption of homogeneous covariance matrices of the dependent variables across groups in MANOVA (Can, 2019). Significance values exceeding .05 confirmed the equality of covariance matrices, a fundamental assumption in MANOVA (Buluş & Şahin, 2022). Similarly, Levene's Test of Equality of Error Variances was conducted to ensure homogeneity of variances, with p-values exceeding .05 indicating variance equality for the dependent variable (Buluş & Şahin, 2022).

Furthermore, to ascertain the absence of multicollinearity issues between variables, it was ensured that there was no correlation above .90 between dependent variables (Pallant, 2020). The analysis revealed no significant correlation issues between the variables of the TPACK scale.

FINDINGS

The first research question analyzed the levels of technological pedagogical content knowledge among visual arts teachers. The findings are displayed in Table 2.

Table 2. Teachers' technological pedagogical content knowledge levels

Scale	Factors	n	$\bar{X}$	sd	Max	Min	Skewness	Kurtosis	Level
Technological pedagogical content knowledge scale	Technological Knowledge	147	3.88	.56	5.00	2.00	-.386	.663	High
	Pedagogical Knowledge	147	4.16	.49	5.00	2.57	-.312	.220	High
	Content Knowledge	147	4.24	.47	5.00	2.88	-.278	.151	High
	Technological Content Knowledge	147	4.95	.52	5.00	2.83	.029	-.260	High
	Pedagogical Content Knowledge	147	4.24	.46	5.00	3.00	.087	-.371	High
	Technological Pedagogical Knowledge	147	4.14	.51	5.00	2.25	-.142	.347	High
	Technological Pedagogical Content Knowledge	147	4.12	.48	5.00	2.75	.125	-.165	High

Table 2 summarizes the levels of technological pedagogical content knowledge among visual arts teachers. Accordingly, visual arts teachers were found to have a high level of technology knowledge ($\bar{X}$ = 3.88), pedagogical knowledge ($\bar{X}$= 4.16), content knowledge ($\bar{X}$ = 4.24), technological content knowledge ($\bar{X}$ = 4.95), pedagogical content knowledge ($\bar{X}$ = 4.24), technological pedagogical knowledge ($\bar{X}$ = 4.14) and technological pedagogical content knowledge ($\bar{X}$ = 4.12).

Based on the second research question, a one-way MANOVA analysis was conducted to determine whether the levels of technological pedagogical content knowledge among visual arts teachers differed across their genders. Table 3 depicts the MANOVA analysis results.

Table 3. One-factor MANOVA results regarding the factors of teachers' technological pedagogical content knowledge by gender

Independent Variable	Pillai’s Trace	F	Hypothesis sd	Error sd	p	η^2
Gender	.054	1.138	7.00	139.00	.34	.05

The analysis results showed that the homogeneity assumption of MANOVA's covariance matrices was not met, yet other assumptions were satisfied. Can (2020) suggests that it is essential to examine the result of Pillai's Trace test when the assumption of homogeneity of covariance matrices is not met in MANOVA. In line with this recommendation, the results of Pillai's Trace test are presented. Table 3 demonstrates no significant difference across the factors of the visual arts teachers' technological pedagogical content knowledge scale concerning gender (F=1.138, p>.05).

Based on the third research question, a one-way MANOVA analysis was conducted to ascertain whether the levels of technological pedagogical content knowledge among visual arts teachers differed across the socio-economic levels of the schools where they work. Table 4 presents the results of the MANOVA analysis.

Table 4. One-factor MANOVA results regarding the factors of teachers' technological pedagogical content knowledge by the socio-economic level of the schools

Independent Variable	Wilk's Lambda	F	Hypothesis sd	Error sd	p	η^2
Socio-economic level	.906	1.00	14.00	276.00	.45	.04

As in Table 4, no significant difference was noted across the factors of the visual arts teachers' technological pedagogical content knowledge scale concerning the socio-economic level of the schools where they work (F=1.00, p>.05).

As regards the fourth research question, a one-way MANOVA analysis was carried out to reveal whether the levels of technological pedagogical content knowledge among visual arts teachers differed across their participation in educational technology-related in-service training courses. Table 5 presents the results of the MANOVA analysis.

Table 5. One-factor MANOVA results regarding the factors of teachers' technological pedagogical content knowledge by participation in in-service training courses

Independent Variable	Wilk's Lambda	F	Hypothesis sd	Error sd	p	η^2
In-service training	.939	1.291	7.00	139.00	.25	.06

Table 5 illustrates no significant difference across the factors of the visual arts teachers' technological pedagogical content knowledge scale regarding their participation in educational technology-related in-service training courses (F=1.291, p>.05).

About the fifth research question, a one-way MANOVA analysis was carried out to determine whether the levels of technological pedagogical content knowledge among visual arts teachers varied across their years of service. Table 6 depicts the results of the MANOVA analysis.

Table 6. One-factor MANOVA results regarding the factors of teachers' technological pedagogical content knowledge by their years of service

Independent Variable	Pillai's Trace	F	Hypothesis sd	Error sd	p	η^2
Year of service	.156	1.091	21.00	417.00	.35	.05

The analysis results highlighted that the homogeneity assumption of MANOVA's covariance matrices was not met, yet other assumptions were satisfied. Since this assumption was not in MANOVA, the results of Pillai's Trace test were presented. Table 6 demonstrates no significant difference across the factors of the visual arts teachers' technological pedagogical content knowledge scale concerning their years of service (F=1.091, p>.05).

DISCUSSION, RESULT AND RECOMMENDATIONS

This study investigated the levels of Technological Pedagogical Content Knowledge (TPACK) among visual arts instructors. The findings revealed a notable proficiency level across various dimensions including technology knowledge, pedagogical knowledge, content knowledge, technological content knowledge, pedagogical content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge. The observed high levels of TPACK among visual arts educators may be attributed to the pervasive influence of technology in contemporary society. In the current landscape, the widespread availability of technological tools such as computers, smartphones, and the internet has led individuals to seamlessly integrate these technologies into various facets of their lives, including their professional pursuits, thereby contributing to the observed outcomes. Similar trends have been noted in prior research conducted by Dogan and Doğan (2022), Karalar and Aslan Altan (2016), Kabakçı Yurdakul (2011), and Çuhadar, Bülbül, and Ilgaz (2013).

No significant differences were found in the factors of the Technological Pedagogical Content Knowledge scale among visual arts teachers based on their gender. This suggests that the TPACK level is likely linked to teachers' commitment to staying informed and up-to-date. More precisely, it implies that dedication to the profession, continuous improvement aligned with the developments required by the age and becoming self-sufficient in areas such as content knowledge, pedagogical knowledge and technological knowledge is not a gender-related situation. Bandura's self-efficacy theory (1977) clarified that feelings of competence among women and men are not influenced by gender. Indeed, various studies were found examining the TPACK levels of teachers across different branches. The results of these studies illustrated that the TPACK levels of teachers did not differ significantly across genders (Orman & Sevgi, 2024; Organ Ulus, 2022; Topçu, 2020; Karadeniz & Vatanartıran, 2015; Jang & Tsai, 2012). These results are congruent with those of the present study.

The findings revealed no significant difference in the factors of the technological pedagogical content knowledge scale among visual arts teachers in terms of the socio-economic level of the school where they work, their participation in in-service training and their years of service. This suggests that TPACK levels among visual arts teachers may not be influenced by factors such as the socio-economic status of the school, participation in educational technology training, or years of experience. The interplay between scientific progress, technology and education as well as advances in the technological field underscore the need for teachers to enhance their technological competence alongside pedagogical and content knowledge. In addition, the transition to distance education for a while after the Covid 19 epidemic that dominated the world in 2020 and the earthquake disaster that affected more than 10 provinces in our country in 2023 made it necessary to integrate the use of digital media into the education system (Başaran, Doğan, Karaoğlu and Şahin, 2020, p. 391). This obligation has compelled all teachers across all demographics, irrespective of gender, years of experience, or the socio-economic status of the schools they serve, to enhance their technological competencies. Gül and Sönmez (2023) investigated the TPACK application competence levels of special education instructors and concluded that the TPACK levels did not differ across variables such as age and years of service. Besides, Doğru and Aydın (2017) examined the TPACK competencies of geography teachers, noting that their competencies showed no variance across years of service. These findings are in line with those of the present study. Based on the findings, various recommendations were provided.

1. The visual arts curriculum should be prepared with careful consideration of technological developments or existing curricula should be updated in parallel with these advancements.

2. Courses within visual arts teacher training programs in higher education should be structured to incorporate TPACK factors. Pre-service visual arts teachers should be offered practice opportunities to experience technology integration into educational practices.

3. Studies can be conducted with a larger participant pool to reveal whether visual arts teachers' TPACK levels vary depending on variables such as their education level (undergraduate, master's degree and doctorate), the university from which they graduated, and the type of school they work in.

4. It is recommended to conduct research employing qualitative data collection methods such as observation and interviews to determine the TPACK levels of visual arts teachers.

CRediT Author Statement: This is a single-author article. The author accepts all the responsibility for the introduction, method, data collection, data analysis, discussion and conclusion.

Conflicts of Interest: The author declares no conflict of interest.

Funding: The author received no financial support for this article.

Ethical Approval An ethics committee decision was issued from Dicle University Rectorate Legal Consultancy dated 18.07 2023 and numbered 530981, and the necessary permissions were obtained to collect data.

Data Availability Statement: The datasets generated during the current study are available from the corresponding author upon reasonable request.

Acknowledgements. I would like to thank the teachers who participated in the research.

REFERENCES

Akbulut, Y. (2011). *Sosyal bilimlerde SPSS uygulamaları*. İstanbul: İdeal Yayınları

Alakoç, Z. (2003). Matematik ögretiminde teknolojik modern ögretim yaklasimlari. *TOJET: The Turkish Online Journal of Educational Technology*, *2*(1).

Azgın, A. O. & Şenler, B. (2018). İlkokullarda görev yapan sınıf öğretmenlerinin teknolojik pedagojik alan bilgilerinin incelenmesi. *Journal of Computer and Education Research,* 6(11), 47-64.

Akyürek, M. İ. (2020). Uzaktan eğitim: Bir alanyazin taramasi. *Medeniyet Eğitim Araştırmaları Dergisi*, *4*(1), 1-9.

Archambault, L., & Crippen, K. (2009). Examining TPACK among k–12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education,* 9(1), 71–88

Başaran, M., Doğan, E., Karaoğlu, E., & Şahin, E. (2020). Koronavirüs (Covıd-19) pandemi sürecinin getirisi olan uzaktan eğitimin etkililiği üzerine bir çalışma. *Academia Eğitim Araştırmaları Dergisi*, *5*(2), 368-397.

Bandura A. (1977). Self-Efficacy: Toward a Unifying Theory of Behavioral Change, *Psychological Review*, 84,191-215.

Bakaç, E., & Özen, R. (2018). Öğretmen adaylarının öz-yönetimli öğrenme hazırbulunuşluk düzeyleri ile teknolojik pedagojik alan bilgisi (TPAB) yeterlikleri arasındaki ilişki. *Education Sciences*, *13*(2), 90-105.

Buluş, M. & Şahin, G. S. (2022). *Adım adım uygulamalı istatistik*. Ankara: Pegem Yayınları.

Bülbül, H. (2021). Görsel sanatlar öğretimi dersinde sınıf öğretmeni adaylarının aktif öğrenme deneyimleri. *Milli Eğitim Dergisi*, *50*(230), 705-724.

Büyüköztürk, Ş., Çakmak, K.E., Akgün, Ö.E., Karadeniz, Ş., & Demirel, F. (2010). *Bilimsel araştırma yöntemleri.* Ankara: Pegem Akademi.

Can, A. (2019). *SPSS ile bilimsel araştırma sürecinde nicel veri analizi*. Ankara: Pegem Akademi Yayınları.

Cambazoğlu Bilici, S. & Baran, E. (2015). Fen bilimleri öğretmenlerinin teknolojik pedagojik alan bilgisine yönelik öz-yeterlik düzeylerinin incelenmesi: Boylamsal bir araştırma. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, *35*(2), 285-306.

Çiğilli, E., & Eryaman, M. Y. (2023). Sınıf Öğretmenlerinin Teknolojik Pedagojik Alan Bilgisi İle 21. Yüzyıl Öğreten Becerileri Algı Düzeyleri Arasındaki İlişkilerin İncelenmesi. *Mediterranean Educational Research Journal/Akdeniz Eğitim Araştırmaları Dergisi*, *17*(44).

Çuhadar, C., Bülbül, T., & Ilgaz, G. (2013). Öğretmen adaylarının bireysel yenilikçilik özellikleri ile TPAB yeterlikleri arasındaki ilişkinin incelenmesi. *İlköğretim Online*, 12(3), 797–807. doi: 10.17051/io.46378

Çoban, G. Ü., Akpınar, E., Baran, B., Sağlam, M. K., Özcan, E., & Kahyaoğlu, Y. (2016). The evaluation of" technological pedagogical content knowledge based argumentation practices" training for science teachers. *Education and Science,* 41(188) , 1-33.

Demirezen, S., & Keleş, H. (2020). Sosyal bilgiler öğretmenlerinin teknolojik pedagojik alan bilgisi yeterliliklerinin çeşitli değişkenlere göre incelenmesi. *Uluslararası Sosyal Bilgilerde Yeni Yaklaşımlar Dergisi*, *4*(1), 131-150.

Doğan, A., & Doğan, İ. (2022). İlkokullarda görev yapmakta olan okul yöneticilerinin teknolojik pedagojik alan bilgisi (TPAB) yeterliliklerinin farklı değişkenler açısından değerlendirilmesi. *Journal of Multidisciplinary Studies in Education*, *6*(2), 39-53.

Doğru, E., & Aydın, F. (2017). Coğrafya öğretmenlerinin teknolojik pedagojik alan bilgisi ile ilgili yeterliliklerinin incelenmesi. *Journal of History Culture and Art Research*, *6*(2), 485-506.

Ekıcı, F. T., & Dereli, F. (2022). Covid-19 pandemisi süresince gerçekleştirilen uzaktan eğitim faaliyetlerinin fen bilgisi öğretmen adaylarının teknolojik pedagojik alan bilgisi özyeterliklerine etkisi. *Fen Matematik Girişimcilik ve Teknoloji Eğitimi Dergisi*, *5*(3), 237-253.

Field, A. (2009*). Discovering statics using SPSS*. London: Sage.

Ho, R. (2006). *Handbook of univariate and multivariate data analysis and interpretation with SPSS*. London & New York: Chapman & Hall.

Horzum, M.B., Akgün, Ö.E., & Öztürk, E.(2014). The Psychometric Properties of the Technological Pedagogical Content Knowledge Scale. *International Online Journal of Educational Sciences,* 6 (3), 544-557.

Jang, S.J. & Tsai, M.F. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. *Computers & Education,* 59, 327-338

Gedik, O., Sönmez, Ö. F., & Yeşiltaş, E. (2019). Sınıf eğitimi öğretmen adaylarının teknolojik pedagojik içerik bilgi yeterliliklerinin incelenmesi. *Eğitim Kuram ve Uygulama Araştırmaları Dergisi*, *5*(2), 187-198.

Gömleksiz, M. N., & Fidan, E. K. (2013). Sınıf öğretmeni adaylarının teknolojik pedagojik içerik bilgisi öz-yeterliklerine ilişkin algı düzeyleri. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, *14*(1), 87-113.

Gül, M. D., & Sönmez, S. (2023). Özel eğitim öğretmenlerinin teknolojik pedagojik alan bilgisi-uygulama yetkinlik düzeylerinin incelenmesi. *Cumhuriyet Uluslararası Eğitim Dergisi*, *12*(3), 701-714.

Gündüz, R. (2018). *Fen ve teknoloji öğretmen adaylarının teknolojik pedagojik alan bilgisi özgüven düzeylerinin incelenmesi* (Master's thesis, İnönü Üniversitesi Eğitim Bilimleri Enstitüsü).

Gürbüz, S., & Şahin, F. (2015). *Sosyal bilimlerde araştırma yöntemleri: Felsefe-yöntem-analiz.* Ankara: Seçkin.

Johnson, B., & Christensen, L. (2014). *Educational research: quantitative, qualitative and mixed approaches.* USA: SAGE Publications.

Kabakçı Yurdakul, I. (2011). Öğretmen adaylarının TPAB yeterliklerinin bilgi ve iletişim teknolojilerini kullanımları açısından incelenmesi. *Hacettepe Üniversitesi Journal of Education*, 40, 397–408

Kalemkuş, F., & Bulut Özek, M. (2022). Ortaokul öğretmenlerinin teknolojik pedagojik içerik bilgisi modeline göre bit entegrasyon yeterliklerinin incelenmesi: Kars ili örneği. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, (61), 52-74.

Karalar, H., & Aslan Altan, B. (2016). Sınıf Öğretmeni Adaylarının teknolojik pedagojik alan bilgisi yeterliklerin ve öğretmen özyeterliklerinin incelenmesi. *Cumhuriyet International Journal of Education-CIJE,* 5 (USOS Özel Sayı), 15 – 30 - 15

Karadeniz, Ş., Vatanartıran, S. (2015). Primary school teachers' technological pedagogical content knowledge. *Elementary Education Online*, *14*(3), 1017-1028.

Karakaya, İ. (2012). Bilimsel araştırma yöntemleri. A. Tanrıöğen (Edt.) Bilimsel araştırma yöntemleri. Ankara: Anı.

Karakuyu, Y., & Karakuyu, A. (2016). Motivasyon ve öz-yeterliğin sınıf öğretmeni adaylarının teknolojik pedagojik alan bilgilerine (TPAB) katkısı. *Uşak Üniversitesi Eğitim Araştırmaları Dergisi*, *2*(1), 89-100.

Kazu, İ. Y. & Yenen, E. T. (2014). Öğretmen yetiştirmede yeni bir yaklaşım: Klinik uygulama. *İlköğretim Online*, 13(3), 796-805

Kırışoğlu, O. T. (2005). Sanatta Eğitim, Görmek Öğrenmek Yaratmak, Pegem Yayıncılık, Ankara.

Koehler, M.J., & Mishra, P. (2009). What is technological pedagogical content knowledge? Contemporary Issues in Technology and Teacher Education, 9(1), 60–70

Kurt, S. (2012). Examining teachers use of computer-based tehnologies: A case study. Education and İnformation Techonologies, 18 (4), 557-570

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017– 1054.

Muijs, D. (2004). Doing quantiative research in education with SPSS. London: Sage.

Organ Ulus, S. (2022). Ortaokul matematik öğretmenlerinin teknolojik pedagojik alan bilgisi algıları ile uzaktan eğitime yönelik tutumları arasındaki ilişkinin incelenmesi. [Yayınlanmamış yüksek lisans tezi]. Maltepe Üniversitesi, İstanbul.

Orman, F., Sevgi, S. (2024). Temel Eğitimden Ortaöğretime Matematik Öğretiminde Öğretmenlerin Teknolojik Pedagojik Alan Bilgisi Algılarının İncelenmesi. *Anadolu üniversitesi eğitim fakültesi dergisi. 8(1), 276-294.*

Özdemir, N., & Erduran, A. (2019). Matematik öğretmenlerinin teknolojik pedagojik alan bilgisine ilişkin yeterliliklerinin değerlendirilmesi. *Manisa Celal Bayar Üniversitesi Eğitim Fakültesi Dergisi,* 7(1), 29-46.

Öztürk, E. ve Horzum, M. B. (2011). Teknolojik pedagojik içerik bilgisi ölçeği'nin Türkçeye uyarlaması. Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi, 12(3), 255-278.

Özsoy, O. (2004). Etkin Öğrenci, Etkin Öğretmen, Etkin Eğitim, Hayat Yayınları, İstanbul.

Pallant, J. (2020). *SPSS survival manual: a step by step guide to data analysis using IBM SPSS.* (7th ed.). Routledge.

Saykal, A., & Sağır, Ş. U. (2021). Sınıf öğretmenlerinin öğretmenlik mesleğine yönelik tutumları ve teknolojik pedagojik alan bilgileri arasındaki ilişkinin incelenmesi. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi*, *1*(40), 99-110.

Seçer, İ. (2017). *SPSS ve LISREL ile pratik veri analizi: Analiz ve raporlaştırma*. (3th ed.). Ankara: Anı Yayıncılık

Shulman, L. S. (1986). Those who understand : Knowledge growth in Teaching. Educational Researcher, 15(2), 4–14.

Tekinarslan, E. (2008). Eğitimciler için temel teknoloji yeterlikleri ölçeğinin geçerlik ve güvenirlik çalışması. Elektronik Sosyal Bilimler Dergisi, 7(26), 186-205.

Topçu, E., & Masal, E. (2020). Matematik öğretmenlerinin teknolojik pedagojik alan bilgisi öz-değerlendirme algılarına bir bakış. *Gazi Eğitim Bilimleri Dergisi*, *6*(1), 147-167.

Yurdakul, I. ve Odabaşı, F. (2013). Teknolojik pedagojik eğitim modeli. (Ed. Kabakçı-Yurdakul, I.). Teknolojik pedagojik eğitime dayalı öğretim teknolojileri ve materyal tasarımı içinde (41-67). Ankara: Anı Yayıncılık.